DOCUMENT RESUME

ED 444 592 IR 020 248

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TITLE The Integration of Technology into a Constructivist Curriculum: Beyond PowerPoint [R].
PUB DATE 2000-00-00
NOTE 7p.; In: Society for Information Technology & Teacher Education International Conference: Proceedings of SITE 2000 (11th, San Diego, California, February 8-12, 2000). Volumes 1-3; see IR 020 112. Figure 1: "The Construction Model used for the creation of the Personally Meaningful Product," is missing.
PUB TYPE Reports - Research (143) -- Speeches/Meeting Papers (150)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Computer Uses in Education; *Constructivism (Learning); *Curriculum Development; *Educational Technology; Higher Education; *Instructional Design; Models
IDENTIFIERS Knowledge Development; *Technology Integration

ABSTRACT

This paper reports on a three-year study of a model that uses the tenets of constructionism to integrate technology into a constructivist curriculum. The model has been used in regular face-to-face courses, in interactive instructional television courses, and in an online course. The following three significant themes emerged from analysis of the data: (1) the nature and characteristics of successful learners; (2) the power of project-based instruction; and (3) the power of interaction and collaboration. The model has proved to be effective both from the standpoint of being able to achieve the course objectives and the students' view of their success and learning in the classes. (Contains 10 references.) (MES)

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ED 444 592

The Integration of Technology Into A Constructivist Curriculum: Beyond PowerPoint•

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Abstract

For teachers who are at the moment in the objectivist's camp, technology usually becomes a tool for a more effective way of transmitting knowledge. In this context, the integration of technology usually takes the form of some type of PowerPoint® presentation or the use of some other multimedia presentation software to supplement teacher-centered instruction. However, for those times when a teacher views knowledge from a constructivist perpective, the question then becomes, how can technology be effectively integrated? This paper is a report on a three year study of a model that uses the tenets of constructionism to integrate technology into a constructivist curriculum. The model has been used in regular face-to-face courses, in interactive instructional televisions courses and an on-line course. The model has proved to be effective both from the stand point of being able to achieve the course objectives and the student's view of their success and learning in the classes.

Introduction

What is knowledge? How does one teach this knowledge to others? Looking at educational pedagogy from a very elementary approach, the way one answers the first question will determine how they approach the answer to the second. One can approach the answers from the standpoint that knowledge exists outside of the learner, that there are fundamental truths and teaching helps learners master them. If this is a person's view of knowledge, then teaching usually takes the form of direct instruction and instructional goals center around students acquiring and repeating factual information. Most printed textbooks are designed for, and many teachers are trained in, this type of model. Students usually read or are told factual information, and then repeat this information as a part of assessment. This model of knowledge is often referred to as the objectivist model.

From another perspective, one can view knowledge as something beyond a set of facts, or concepts, or laws that are to be memorized. One can possess a view of knowledge that incorporates an understanding of causes and effects involving ideas and actions that requires the use of higher-order or critical thinking skills. This view does not conceive knowledge as something that exists independent of a knower. Zahorik (1995, pp. 11-12) summarized this view of knowledge in the following way:

> *Knowledge is constructed by humans.* Knowledge is not a set of facts, concepts, or laws waiting to be discovered. It is not something that exists independent of a knower. Humans create or construct knowledge as they attempt to bring meaning to their experience. Everything that we know, we have made.
>
> *Knowledge is conjectural and fallible.* Since knowledge is a construction of humans and humans are constantly undergoing new experiences, knowledge can never be stable. The understandings that we invent are always tentative and incomplete.

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Knowledge grows through exposure. Understanding becomes deeper and stronger if one tests it against new encounters.

This model of knowledge is often referred to as the constructivist model. Constructivism's central idea is that human learning is constructed, that learners build new knowledge upon the foundation of previous learning. The constructivist model relies on cognitive psychology for much of its theoretical foundation and has roots in philosophy, sociology, and education. It is important to understand the implications this view of learning has for teaching. The Southwest Educational Development Laboratory News (SEDLetter) in August, 1996 stated:

> First, teaching cannot be viewed as the transmission of knowledge from enlightened to unenlightened; constructivist teachers do not take the role of the "sage on the stage." Rather, teachers act as "guides on the side" who provide students with opportunities to test the adequacy of their current understandings.
>
> Second, if learning is based on prior knowledge, then teachers must note that knowledge and provide learning environments that exploit inconsistencies between learners' current understandings and the new experiences before them. This challenges teachers, for they cannot assume that all children understand something in the same way. Further, children may need different experiences to advance to different levels of understanding
>
> Third, if students must apply their current understandings in new situations in order to build new knowledge, then teachers must engage students in learning, bringing students' current understandings to the forefront. Teachers can ensure that learning experiences incorporate problems that are important to students, not those that are primarily important to teachers and the educational system ....
>
> Fourth, if new knowledge is actively built, then time is needed to build it ...

In educational pedagogy, the reality of the situation is, teachers can find themselves in both the objectivist's camp and the constructivist's camp depending upon the objectives they are targeting. There are times in our classrooms that we are actively involved in the "transmission of knowledge from enlightened to unenlightened." There are others times that our learning objectives are such that we do our best to create situations where "students must apply their current understandings in new situations in order to build new knowledge." Teaching is often described as being an art. The art of becoming a master teacher can be seen as an awareness of when to be in one camp or the other and an understanding of how to be effective no matter what camp one is in.

In contemporary education, the complexity of teaching and learning has been heightened with the integration of modern technology. For teachers who are (at the moment) in the objectivist's camp, technology becomes a tool for a more effective way of transmitting knowledge. In this context, the integration of technology usually takes the form of some type of PowerPoint® presentation or the use of some other multimedia presentation software to supplement teacher-centered instruction. But for those times when a teacher views knowledge from a constructivist perspective, the question then becomes, how can technology be effectively integrated?

Constructivism and Technology Integration

In social and developmental psychology, according to von Glasersfeld (1994), constructivist models view the learner as a builder of knowledge, not a passive receptor, but an active constructor. Two important notions orbit around the simple idea of constructed knowledge:

2468

The first is that learners construct new understandings using what they already know. There is no *tabula rasa* on which new knowledge is etched. Rather, learners come to learning situations with knowledge gained from previous experience, and that prior knowledge influences what new or modified knowledge they will construct from new learning experiences. The second notion is that learning is active rather than passive. Learners confront their understanding in light of what they encounter in the new learning situation. If what learners encounter is inconsistent with their current understanding, their understanding can change to accommodate new experience. Learners remain active throughout this process: they apply current understandings, note relevant elements in new learning experiences, judge the consistency of prior and emerging knowledge, and based on that judgment, they can modify knowledge. (SEDLetter, August, 1996):

> If learning is a constructive process, and instruction must be designed to provide opportunities for such construction, then how can technology be integrated into the instructional processes such that it promotes teachers to teach in "constructivist's ways?" The answer may come form a series of research studies described as *constructionism*.

In the 1960's, Seymour Papert and colleagues initiated a research project on how children think and learn and to develop educational approaches and technological tools to help those children learn. From this beginning has evolved a theoretical foundation, which has become known as constuctionism. The term constructionism, first coined by Papert (1991), involves two main tenets. First, it affirms the constructivists view of learning and asserts that knowledge is not simply transmitted from teacher to student, but actively constructed by the mind of the learner (Kafai and Resnick, 1996). To this constructionism adds the idea that people construct new knowledge with particular effectiveness when they are engaged in constructing *personally meaningful products* (Bruckman & Resnick, 1996). Thus constructionism involves the construction of knowledge in the context of building personally meaningful products (Kafai and Resnick, 1996). It is perhaps through this avenue of "constructing" that technology can be integrated into the instructional process such that it promotes teachers to teach from a constructivist model. This was the premise in the development and research of the curriculum model discussed here in.

The Model

The curriculum model that was implemented was designed around constructionist reseach emphasizing that "constructing" be done in the framework of *personally meaningful products*. The blending of course objectives and personal meaningfulness into a single coherent design while adhering to constructivist ideals is what this curriculum model hoped to achieve. Csikszentmihalyi (1997) in his research on creativity found that when a person likes what he does and is motivated by it, focusing the mind becomes effortless even when the objective difficulties are great. However, this meaningfulness must also exist within the context of the learning goals of the course.

In Phase I, the student working with the teacher establish the specific topic to be studied based largely on the personal environment of the learner and the learning goals of the course. Learner's abilities, learning style preferences, the availability of materials, resources and facilities, and the learners understanding of the academic goals for the class influence the choice of product to be produced. As stated before, achieving "meaningfulness" is difficult, for this reason each student was required to submit a narrative that establishes for a reader why the Personally Meaningful Product has personal meaning

In Phase II, a plan of action is developed and the nature of the product to be produced is determined. It is critical that the learner understand that there has to be some tangible creative product that is the result of this process. This must be a created object or artifact that is external to the creator, something "in the world" that can be "shown, discussed, examined, probed, and admired" (Papert, 1980, 1991, 1993). Sharing a creation will result not only in the learner obtaining a deeper understanding of other people's perspective on the object and on the ideas to which it is related but it will also provide the completion of the human experience of creativity.

Figure 1: The Construction Model used for the creation of the Personally Meaningful Product.

During Phase III, the Construction Phase, the learner hopefully will become immersed in the creative process and gain a personal understanding of "Flow" (Csikszentmihalyi, 1997).

> "What is common to such moments is that consciousness is full of experiences, and these experiences are in harmony with each other. Contrary to what happens all too often in everyday life, in moments such as these what we feel, what we wish, and what we think are in harmony. These exceptional moments are what I have called flow experiences. The metaphor of 'flow' is one that many people have used to describe the sense of effortless action they feel in moments that stand out as the best in their lives. Athletes refer to it as 'being in the zone,' (p. 29)

The role of the teacher at this phase is to provide guidance and clarification by observing, listening, and offering helpful feedback as required. During this phase, much valuable information about process skill mastery, content acquisition, personal learning style, and other factors are obtained and help guide the direction of the project.

The final phase is the Evaluation Phase where the product is exhibited for peers, adults, and the instructor to view, admire, discuss and provide feedback. The importance of this phase is not to be underestimated. It is important that the product be viewed by a variety of groups all of which provide feedback to the learners.

Testing the Model

The pilot semester for the model was Spring Semester 1998. Students enrolled in the course that semester represented a diverse range of educational backgrounds as well as a wide range of familiarity with technology. Of the eight students enrolled, only two had any extensive experience with technology. The majority of the class had used computer technology to write papers for their studies, and one had virtually no experience with technology in any form. Degree programs represented in the course ranged from anthropology to English to curriculum and instruction. Several students were completing doctoral programs while others were at the master's level.

The course was held once a week for a three-hour evening session. Each session was usually segmented so that students and the instructor met as a seminar for part of the evening and broke into project work for the remainder of the session. During the project portion of the class, students could opt to work with other students or work independently on their own work in progress. Every student was equipped with a laptop computer that not only served as their link to project design, but also allowed them to keep in touch with other students and the instructor at any time. The software provided by the instructor also gave students avenues to connect students with other sources and agencies of expertise that would help support individual projects.

Outside of class time students could use this same technology to reach the instructor and other students for help or advice. students used a "web-based" conferencing software provided by the university that created a "Virtual Conference Center" (VCC) which gave students a place to collaborate on-line at their own convenience. The VCC was available at any time e and from any location, allowing interactions between students to occur even when separated by time and distance. The conference software also archived all conversations so the writer, instructor, or other classmates could visit or revisit interactions at any time. As a distributed constructionist model of learning advocates, the means for communication between students, and between students and instructor were readily available for collaboration about course content and individual projects within and outside class time. As a constructionist model of learning advocates, the means for communication between students, and between students and instructor were readily available for collaboration about course content and individual projects within and outside class time.

Data Collection and Findings From the Pilot Study

The instructor and the students evaluated the course twice during the semester. At mid-term students were asked to write a report that included evaluation of five aspects of the course: the readings, interactions with others, individual projects, the instructor, and oneself. At this point in the course, the instructor wrote his own evaluation of the students, their progress with projects, and their understanding of constructionism. . At the end of the course both students and instructor repeated these tasks In addition to the evaluation process, the instructor and the students in the class were individually interviewed during the second half of the semester.

From the analysis of the data, three significant themes emerged. All are strongly tied to the guiding tenets of constructionism. While data touched on other issues and concerns, these three themes were strongly represented in a wide cross section of data sources.

Theme One: The Nature and Characteristics of Successful Learners
Theme Two: The Power of Project-Based Instruction
Theme Three: The Power of Interaction and Collaboration

Students in this course represented a diverse range of educational backgrounds as well as a wide range in familiarity and use of technology. Even with such diverse backgrounds, students in this course were almost unanimous in describing the characteristics of someone who would be a successful learner in this course. To be successful in a course based on a constructionist theory of learning, a student must be a "self starter", highly motivated to learn and explore without constant reassurance from the instructor both within and outside class time. This includes a willingness to make mistakes while learning something totally new. Along with this, a successful student must be able to search for multiple sources of information and assistance and be flexible enough to listen to feedback from those sources.

Several students cautioned that learners who need to be told what to do or what to pay attention to would fail miserably in this course. "People that need 'today were going to learn about..' and have their hands up all the time to say 'guide me and I'll be okay' are going to feel lost in this type of class". The characteristics of successful learners described by course students emphasize the active nature of learning demanded by a constructionist notion of instruction. Students in this type of learning environment are not passive recipients of knowledge, but must be actively and passionately involved in their own learning.

One of the reasons that students cited for their own feeling of success in this course was the project-centered learning. In both evaluation and interview data students reported that working on a project that had personal meaning to them opened up new realms of possibilities. "This project was so useful to me and others [in the class]. I was initially skeptical, but this has turned into an enormous personal experience (EG, interview). This student went on to say that to make decisions, find the appropriate resources and to create something with them is something she is confident that she will be able to continue to do well after the course is over.

The ability to interact with a variety of people, in and outside class time was found to be a key component for success in this course. Students reported that at the beginning of the course the nature of these interactions were almost more social than academic. "You can do it", Let's meet for coffee and discuss the hot buttons for your web site helped them to form bonds with other students. Once the course was underway interactions over the web and in class helped the class develop into a true learning community.

Conclusions

As a model for course design in educational technology, distributed constructionism shows a great deal of potential. In a field in which both content and process are ever evolving, distributed constructionism allows for students to begin with the knowledge, skills, and dispositions that they bring to new courses and use these as a basis to create new understandings. The structure in which these new understandings must take place within, however, must be well thought out and provide students opportunities to engage in active, collaborative experiences that facilitate new learning. With further refinements, distributed constructionist models for learning may allow students to grow in ways that traditional courses don't. ECI 751 shows that

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project learning is powerful and meaningful for both students and instructor. We advocate the use of such a model to design educational technology courses

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